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VOL. XX, No. 43 NOVEMBER 15, 1941 GUY P. JONES
Editor

LABORATORY DETERMINATION OF NUTRITIONAL STATUS*

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Deviations from normal nutrition, the subclinical states of undernutrition, and the recognition of actual clinical entities such as scurvy, are essentially medical problems. This is because nutrition is a bodily process. The clinician, as usual, must await the results of the laboratory worker, the physiologist and the biochemist. Such waiting for ways and means of making an accurate nutritional appraisal has been a patience trying procedure. To the pediatrist, it has been a doubly trying time. He deals with a rapidly growing organism. He can not avoid being conscious of the predisposing causes of infection and disease, such as environment and malnutrition. As a pediatrician, I sometimes believe that the specialty I represent is the most important aspect of clinical medicine. At least we can agree that citizens of the future present a far more urgent problem in National defense than Dr. Townsend's "elder citizens."

Most of us are capable of making a diagnosis of rickets, scurvy, anemia or pellagra. We also realize that in the case of scurvy there is usually an incubation period of six months—the so-called latent period. The same thing is true of every deficiency disease—they don't rise up and strike us down—they are all preceded by latent periods and it is to these periods that our attention must be directed.

Another concept which I would like to state clearly in this introduction is that not all nutritional deficiencies are due to lack of vitamins. Many are due to mineral imbalance or lack of assimilation. Still other groups of nutritional disturbances are due to lack of, or disturbance of, protein metabolism. The nutritional edema of the allergic child starved with an elimination diet is an example of this. Celiac disease with its subsequent dwarfing is due possibly to a combined disturbance of carbohydrate and fat metabolism. We must also recognize the fact that dental caries is in some ways a nutritional disturbance.

In one capacity or another I have been over a considerable portion of the State. The incidence of undernutrition is high—higher in some sections than others. Figures are not available, and for my immediate purpose here are unimportant. Wherever clinical observations have been made, whether by physicians or nutritionists, one gets the impression that education in nutrition plus the availability of the elements of good nutrition has performed "miracles." The factors producing or causing these conditions are so complex, so interrelated with such widely divergent factors as intelligence of the mother, housing, and income that it is difficult to say just what the effects of better nutritional intake have been. Is it possible then, to evaluate these factors by objective means?

The problem of making just such a nutritional appraisal by clinical and laboratory methods is particularly pertinent at this time. The California State Department of Health with members of the California Nutrition Committee as their advisors (and probably supported by private foundations), are now about to undertake a nutritional survey of children in certain areas of California in an attempt to show by these clinical and laboratory evaluations what can be done for the improvement of nutritional status with the school lunch. A common denominator such as a pellet filled with necessary minerals and vitamins and/or by a nutritional sandwich, candy bar or fortified milk may be used. If the evaluation is successful and it is shown by scientific means at our disposal that some one of these methods will raise the nutritional status of a group, the ramifications in terms of National defense will be tremendous. It is hoped that again California and Californians will show the way in demonstrating the effects of the "miracles of nutrition."

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* Paper read before the Conference on Nutrition in the National Defense, May 2-3, 1941, held under the auspices of the California Nutrition Committee, a National defense organization.

But what means of evaluation shall we choose? Will it be intensive anthropometry; will it be roentgenographic studies; will it be simple height-weight measurements, studying average monthly gain; will it be intelligence quotient studies; or will it be the use of biochemical tests? These are some of the problems which confront your committee. It was in order to formulate in my own mind what is good and what is practical from the bales of printed material at our disposal which impelled me to undertake this particular paper.

CLINICAL METHODS OF NUTRITIONAL APPRAISAL

Most clinical methods for screening out those children in poor states of physical fitness from those who are normal, "optimal" or "average" have been found wanting. No attempt can be made here to review the different methods of evaluating physical fitness. It has been shown that there is but 50-70 per cent agreement among the most experienced physicians as to what constitutes undernutrition. Other studies using height-weight tables, plus an appraisal by physicians, seem to possess an over all reliability of no more than 60 per cent. However, one recent review should be called to your attention. Jenss and Souther of the Children's Bureau have used four different indices (The Baldwin Wood Tables, The A. C. H. (arm-chest-hip) Index, the Nutritional Status Index of Franzan and the Pryor Width-Weight Tables) in a study to determine the physical fitness of New Haven school children. Although they gained valuable information which may be usable for our purpose, they conclude that these methods have not proved efficient and other procedures must be found. This study is an important landmark because it was a study to end all such studies.

These discrepancies on the part of the physicians and tests, obviously, are not so much the fault of the physician but rather of the tests. These indices mentioned above are neither selective or sensitive enough. They fail to identify a considerable number of boys and girls who are in need of medical care and nutritional assistance by some other selective criterion, and they do select others who are in no need.

The test or tests of the future must take into consideration at least three aspects of child health—his physical condition, his growth and development, and his dietary habits. They must also meet, if humanly possible, (and particularly for our immediate local needs) the conditions stipulated by Jones, i.e., measurements of physical fitness must be limited to those which can be easily made in office or school, no recalculation of basic data should be necessary, no extra time or labor should be involved. To this end a unique method, recently published, has been devised by Wetzel.*

A grid technique of evaluating physical fitness has been designed by that author. It is intended to be used as a record of, and a guide to, individual progress throughout childhood to maturity. It is objective and simple in operation. It would be useful in private practice or with large groups of children who need some screening device. If the results as stated by the author are verified they should give an accurate estimate of the extent and distribution of malnutrition in any community. By actual test on approximately 2,100 school children the grid rating was compared with physicians' estimates. Agreement was reached in about 94 per cent. Moreover, the grid caught 94.5 per cent of the subjects called "poor" or "borderline" by physicians. It was not intended to get away from the judgment of the physician.

Whether or not Wetzel's view that physical fitness implies "normal" growth and development and physical unfitness is invariably associated with disturbances of growth and nutrition remains to be proven, yet his approach for the first time, I believe, has given us a precise yet simple means of making an objective evaluation of nutritional status, its regression and progression.

INVESTIGATION OF DIETARY

Dietary inquiry into the habits and environment of the child as a means of estimating his nutritional status have been disappointing except as an adjunct. Detailed inquiry is most difficult, it is expensive, time consuming and frequently unreliable except when taken by the most highly trained workers with complete cooperation of mother and child.

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* Wetzel, N. C.: Physical Fitness in Terms of Physique, Development and Basal Metabolism with a Guide to Individual Progress from Infancy to Maturity, J. A. M. A., 116:1187, 1941.

BIOCHEMICAL TESTS AND TESTS BY PHYSICAL APPARATUS FOR SPECIFIC NUTRITIONAL DEFICIENCIES

Most tests of this kind are complicated and expensive—lacking sensitivity and specificity and measure only a particular nutritional deficiency. We are, however, rapidly approaching the time when many of these tests are entirely practical and when used in conjunction and correlated with other means give us our best opportunity for making an accurate nutritional appraisal.

No attempt will be made here to give details of laboratory technique. I will, therefore, attempt to state as concisely as possible what I have been able to gather from my experience as well as from my colleagues in the laboratory field of nutrition as to what is practical and what we can use of these tests for our immediate local purposes.

VITAMIN A

The main clinical conditions resulting from lack of vitamin A are night blindness, xerophthalmia, certain skin changes, lowering of resistance to infection and diminished rate of growth.

At least three major tests are available and have been used to determine avitaminosis A.

(1) MEASUREMENT OF ADAPTATION TO DARKNESS OR TWILIGHT VISION

Briefly, this test is based on the formation of visual purple in the eye. When vitamin A is diminished or absent, visual purple is absent and relative degrees of night blindness occur. The methods of measuring this is by a photomotor of which there are several types with technical improvement constantly being made.

After due consideration, I believe that the possibility of detecting latent, subclinical avitaminosis A by means of a visual test can be answered with reasonable optimism. Given a good instrument and a good technician, one can say with reasonable certainty that a given individual has, for example, an abnormal dark adaptation curve. Furthermore, it is the general impression in our clinic that dark adaptation returns to normal with vitamin A administration.

(2) MICROSCOPIC TESTS

Microscopic tests for vitamin A consist of scrapings of conjunctivae, cornea, and nasal mucous membrane which may show keratinization.

(3) BIOCHEMICAL TESTS

Recently, a reliable method * (the antimony trichloride method) using a photoelectric colorimeter has been developed for the estimation of vitamin A and carotenoids in blood serum or plasma. Deficiency of vitamin A in infants and children can be detected to be at a low level before other reliable clinical signs appear. No correlations so far have been made with other tests mentioned above and this is most necessary.

VITAMIN B_1 (THIAMIN)

We need vitamin B_1 (thiamin) to assist in carbohydrate metabolism. Cocarboxylase is an intermediate product of carbohydrate metabolism and vitamin B_1 helps to complete the metabolism. The amount of this vitamin needed in the body is proportionate to the amount of carbohydrate utilized. When there is a deficiency of thiamin, the pyruvic acid which should normally be burned to acetic acid and carbon dioxide accumulates in the cells of the body and energy which could be obtained from the carbohydrate is not completely available. Vitamin B_1 is also essential for normal function of nerve tissue.

A modified method * (the thiochrome reaction) has been worked out and reported by Borson. It depends on the following reaction: Thiamin oxidized by an appropriate amount of ferricyanide in strongly alkalin solution is converted quantitatively into thiochrome which fluoresces intensely blue in ultra-violet light. The intensity of the fluoresence varies with the amount of thiochrome present and may be measured with a photoelectric colorimeter or by visual comparison with standards. This method is entirely practical and provides an easy, rapid, and accurate method for the chemical assay of thiamin (vitamin B_1) in urine.

The extent of a deficiency in vitamin B_1 may be estimated by determining the number of test doses (.1 mgm. per kilo by mouth) required for the excretion to rise to normal. Patients with severe thiamin deficiency require approximately 100 mgms. administered in order for the excretion to become normal. Subjects known to be taking a diet adequate in thiamin excrete in the urine 100-300 micrograms daily.

(Continued in next issue)

FROZEN EGGS

Shipments of frozen egg products in California during October reached a total of 483,000 pounds, all of which were wholesome and passed for human consumption. In one city nearly 70,000 pounds of frozen whole eggs packed locally were placed under quarantine.

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* May, Blackfan, McCreary and Allen: Clinical Studies of Vitamin A in Infants and in Children, Am. J. Dis. Child., 59:1167, 1940.

* Borson: Clinical Application of the Thiochrome Reaction in the Study of Thiamin (Vitamin B_1) Deficiency, Ann. Int. Med., 14, July 1940.

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EFFECT OF PUMICITE DUST ON LUNGS

In 1940, engineers of the United States Bureau of Reclamation who are exposed to pumicite dust during the construction of a dam in the Central Valley Water Project, were given complete physical examinations, including chest X-rays and blood serological tests. Reexamination of these men after one year's dust exposure did not reveal any pathological lung changes which might be due to dust inhalation. These examinations will be repeated annually during the construction period. The interpretation of chest X-ray films has been confirmed by the Division of Industrial Hygiene, National Institute of Health. One employee, who was found upon examination to have an active pulmonary infection not related to his employment, has been placed under medical care.

Atmospheric dust counts made during October at the pumicite quarry and concrete mixing plant at the dam showed marked reduction in dust concentrations as a result of the wetting down of road beds at the quarry, and enclosure and exhaust ventilation of mixing machinery. These measures were instituted on the basis of previous studies and recommendations made by Industrial Hygiene Service.

SAN MATEO HEALTH DEPARTMENT

The cities of Atherton and South San Francisco have transferred the administration of their public health affairs to the San Mateo County Health Department of which Dr. Charles C. Gans is health officer. With the inclusion of these two cities in the San Mateo County health unit nearly all of the geographical area of the county is under the administration of Dr. Gans.

MORBIDITY

Complete Reports for Following Diseases for Week Ending November 8, 1941

Chickenpox

536 cases from the following counties: Alameda 136, Contra Costa 11, Fresno 29, Kern 9, Los Angeles 90, Merced 1, Monterey 6, Nevada 1, Orange 3, Plumas 8, Riverside 25, Sacramento 26, San Bernardino 27, San Diego 29, San Francisco 42, San Joaquin 24, San Mateo 4, Santa Barbara 18, Santa Clara 7, Santa Cruz 4, Siskiyou 14, Solano 4, Sonoma 7, Stanislaus 2, Tulare 3, Ventura 1, Yolo 5.

German Measles

96 cases from the following counties: Alameda 9, Fresno 1, Los Angeles 23, Monterey 5, Nevada 1, Orange 7, Plumas 1, Sacramento 2, San Diego 8, San Francisco 8, San Joaquin 1, San Luis Obispo 1, San Mateo 1, Santa Barbara 23, Santa Clara 3, Santa Cruz 1, Siskiyou 1.

Measles

298 cases from the following counties: Alameda 23, Butte 2, Contra Costa 2, Fresno 2, Humboldt 1, Kern 5, Lassen 13, Los Angeles 31, Madera 8, Marin 1, Merced 1, Monterey 19, Riverside 2, Sacramento 2, San Benito 5, San Bernardino 10, San Diego 3, San Francisco 6, San Joaquin 92, Santa Barbara 1, Santa Clara 2, Santa Cruz 2, Siskiyou 1, Sonoma 20, Tulare 16, Ventura 28.

Mumps

746 cases from the following counties: Alameda 43, Butte 1, Colusa 5, Contra Costa 7, Fresno 12, Imperial 8, Kern 25, Lassen 25, Los Angeles 145, Monterey 9, Orange 55, Riverside 23, Sacramento 19, San Bernardino 14, San Diego 45, San Francisco 47, San Joaquin 112, San Luis Obispo 18, San Mateo 17, Santa Barbara 28, Santa Clara 32, Santa Cruz 12, Shasta 1, Solano 10, Sonoma 11, Stanislaus 5, Tulare 1, Ventura 7, Yolo 7, Yuba 2.

Scarlet Fever

99 cases from the following counties: Alameda 5, Colusa 1, Contra Costa 1, Fresno 1, Kern 1, Los Angeles 46, Madera 1, Orange 4, Riverside 4, Sacramento 2, San Bernardino 2, San Diego 10, San Francisco 4, San Joaquin 1, San Luis Obispo 1, Santa Barbara 5, Santa Clara 1, Solano 4, Sonoma 1, Tulare 1, Ventura 1, Yolo 1, Yuba 1.

Whooping Cough

177 cases from the following counties: Alameda 24, Butte 2, Fresno 11, Kern 1, Kings 2, Los Angeles 52, Modoc 3, Orange 1, Riverside 1, Sacramento 1, San Benito 1, San Bernardino 1, San Diego 13, San Francisco 2, San Joaquin 14, San Luis Obispo 1, Santa Barbara 13, Santa Clara 8, Santa Cruz 3, Solano 5, Sonoma 2, Sutter 4, Tulare 8, Ventura 1, Yolo 3.

Botulism

5 cases from Alameda County.

Coccidioidal Granuloma

2 cases from Tulare County.

Diphtheria

15 cases from the following counties: Fresno 1, Imperial 1, Los Angeles 4, Riverside 1, Sacramento 2, San Bernardino 3, San Luis Obispo 1, Stanislaus 1, Tulare 1.

Dysentery (Bacillary)

6 cases from the following counties: Los Angeles 3, Monterey 1, Sonoma 1, Ventura 1.

Encephalitis (Epidemic)

One case from Fresno County (Fresno).

Food Poisoning

5 cases from the following counties: Alameda 3, Los Angeles 2.

Jaundice (Epidemic)

3 cases from the following counties: Los Angeles 2, San Bernardino 1.

Malaria

One case from Yolo County.

Meningitis (Epidemic)

4 cases from the following counties: Los Angeles 1, San Joaquin 1, Tulare 2.

Paratyphoid Fever

One case from San Francisco.

Poliomyelitis

6 cases: Kern County 1 (Bakersfield rural); Los Angeles County 1 (Los Angeles); San Diego County 4 (San Diego).

Rabies (Animal)

3 cases from the following counties: Imperial 1, Monterey 1, Santa Clara 1.

Tularemia

One case from Siskiyou County.

Typhoid Fever

4 cases from the following counties: Riverside 1, Santa Clara 2, California 1.*

Undulant Fever

7 cases from the following counties: Kern 4, Los Angeles 3.

* Cases charged to "California" represent patients ill before entering the State or those who contracted their illness traveling about the State throughout the incubation period of the disease. These cases are not chargeable to any one locality.

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